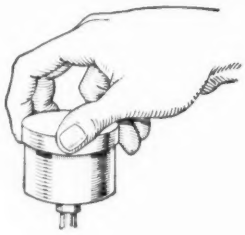
Volume 14 119 December, 1928 *Number 12*

Lubrication

THIS ISSUE

The Means
of
Pressure Lubrication

PUBLISHED MONTHLY BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS



Pressure Lubrication Involves more than this Now-a-days!

Pressure lubrication, in the old days, meant giving a few turns to the caps of the grease cups—and trusting that the lubricant would get to the spot required.

Now-a-days, with speeds and pressure far different than what they used to be, more positive means of oil or grease application are required.

Consequently, industry has turned extensively to mechanical pressure lubrication.

With this change, the human element in regulating lubricating pressures has been largely eliminated; but the necessity for alertness in the *kind* and *amount* of lubricant to use has been increased.

This issue of Lubrication, therefore, is devoted to an explanation of modern pressure lubrication devices and the kind of lubricant best suited to each type.

We speak with authority on this subject. We have studied it extensively; and much of our information is the result of actual experience on machinery within our own plants and throughout plants of thousands of satisfied TEXACO customers.

We can furnish you a time tested TEXACO Lubricant that will work most effectively and economically on any system of pressure lubrication you are using.

THE TEXAS COMPANY

Texaco Petroleum Products

Dept. H, 17 Battery Place, New York City

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LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

Published Monthly by

The Texas Company, 17 Battery Place, New York City

Vol. XIV December, 1928 No. 12

Change of Address: In reporting change of address kindly give both old and new addresses.

The Means of Pressure Lubrication

IN the course of studying the various phases of industrial, power plant and automotive machinery lubrication, application of lubricants under more or less pressure has been frequently mentioned in the pages of LUBRICATION. It is a most important factor in the attainment of positive and dependable lubrication of certain types of mechanical equipment. Notably the automotive engine, the metal press, the air compressor and other machinery wherein working pressures between many of the moving elements may be comparatively high at certain stages of operation.

As a result a more detailed discussion of the principles involved in the several types of pressure lubricators should be of decided interest.

Pressure lubrication in its simplest form may be said to have been embodied in the compression grease cup. In the beginning, manual pressure as developed by screwing down the cap or plunger element in the above was sufficient to meet the existing pressure and speed requirements of the parts involved. It is still used today where unit cost of installation must be low, where labor can be depended upon and where the load imposed upon the parts to be lubricated may not be too severe.

Where production requirements are intensive, however, or where certain of the moving parts may be so located as to render it hazardous during operation for an operator to attempt to adjust any individual lubricator, more positive means of oil or grease application must be sought. It should not be inferred that the individual compression grease cup is not positive; it is, but not dependably so, for delivery of lubricant as brought about direct, by hand pressure alone, cannot be uniform nor can the length of time be determined over which it may be relied upon.

In consequence, industry has turned extensively to mechanical pressure. This may be broadly regarded as involving spring pressure, or the action of the screw or lever as applied to grease; and the direct connected gear or rotary pump, or mechanical force feed oiler, as applied to oil.

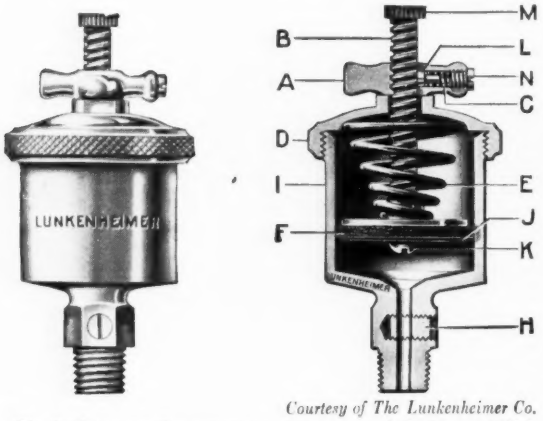
Spring pressure is a distinctly mechanical action; on the other hand, where a plunger alone is involved, this latter may in turn be actuated by compressed air, by electricity or by a suitable hand or foot pump mechanism. In chart form this is shown below:

Grease Lubrication.....	by spring actuated plunger	
	by power actuated plunger	using compressed air, electric power, or a hand or foot operated pump involving lever or screw action
Oil Lubrication	mechanical operation by	chain or shaft driven gear pump, mechanical force feed lubricator
	plunger operation	hand or foot power

Grease Lubrication

SPRING TYPE LUBRICATORS

There are two broad types of spring actuated grease lubricators as shown in Figures 1 and 2. Both are of the automatic feed type; Figure 1 shows a hand adjusted device, whereas Figure 2



Courtesy of The Lunkenheimer Co.

Fig. 1—A compression grease cup of the automatic feed type. "F" is a leather packed plunger, under pressure of steel spring "E". The regulating screw "H" controls the delivery of lubricant into the bearing. "A" is the control handle, "B" the plunger stem, and "L", "C", and "N" a spring locking mechanism to prevent alteration of plunger adjustment, due to vibration.

is more nearly automatic, and frequently more cleanly, especially when filling, inasmuch as this latter is accomplished by means of a pressure gun. In operation this type is the more positive and dependable in view of the fact that pressure is more constantly exerted on the grease contained therein. This will normally insure flow of lubricant to meet the bearing requirements until the reservoir is practically emptied.

With the hand pressure or screw-down type of cup, pressure is frequently not as constant nor as dependable. It will be greatest at the time of adjustment, depending on the number of turns, the size of the spring and the extent to which this latter may be compressed.

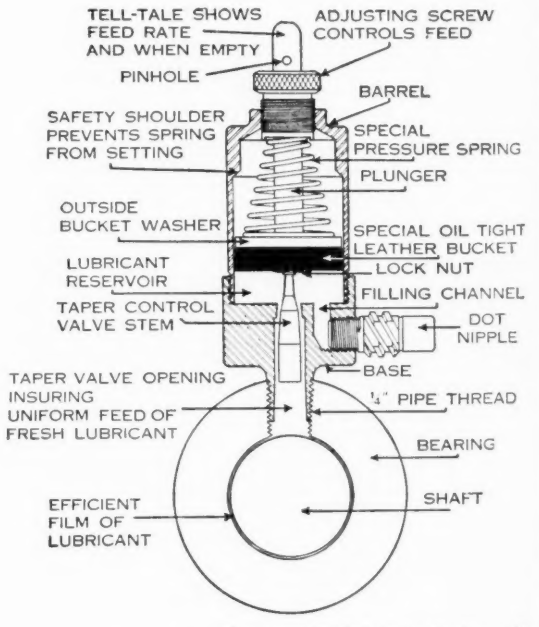
The Pressure Gun an Adjunct

The combination of the pressure grease gun plus the spring type cup is decidedly advantageous for the lubrication of inaccessible or hazardously located bearings on many types of machinery. As a general rule, by using a spring of particular tension plus a suitable orifice, flow of grease therefrom can be very accurately controlled. Furthermore, it can be noted by observation of the indicator with which such lubricators are usually equipped.

Filling of such a cup is a simple and cleanly matter. It merely amounts to attaching the pressure gun to the fitting located in the base of the cup. There is no necessity for removal of the cover, as may be true with those cups which are more strictly of the hand pressure type. In consequence there is more positive assurance that the grease charge will not become contaminated through possible entry of dust or dirt.

The next step is to shoot grease into the cup until the indicator rises to its full height to show that the cup has been completely filled.

The initial pressure for such filling may be obtained by use of compressed air, electric power, or simply hand or foot power, according to the type of gun and the pressure desired. The former develop considerably higher pressures than the latter. Of course, where a relatively simple hand pressure grease gun is used, the impression may be gained that this should be classified with the hand pressure or screw-down type of cup as shown in Figure 1. We must, however, remember that hand pressure as applied to a grease gun does not react directly on the bearing; it must first be converted to mechanical energy by doing work in compressing the spring in the grease cup. From



Courtesy of Dot Lubricating Equipment Co.

Fig. 2— Details of the adjustable automatic Dot-o-Matic pressure cup designed for positive uniform delivery of grease to bearings. Principles of construction are clearly illustrated.

this point on lubrication is automatically maintained by the mechanical action of the spring upon the adjacent plunger which bears upon the grease charge to force it through the bearing.

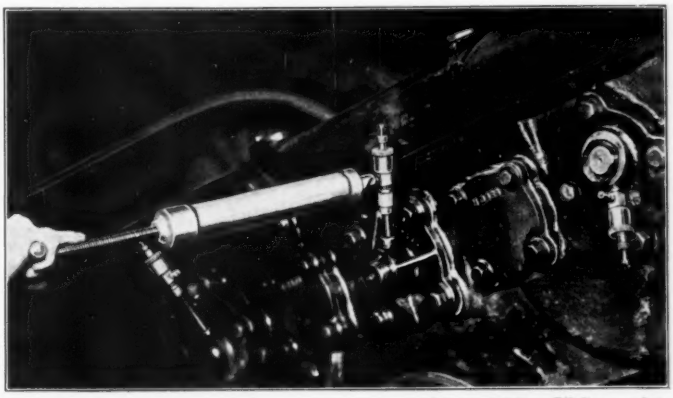
THE POWER DRIVEN GREASE LUBRICATOR

In certain phases of industry, however, grease lubrication under considerably higher pressures than can be attained through the average spring type or screw-down cup will be essential. Here the question of positive and complete cleaning of bearing clearance spaces and oil grooves (where included), prior to re-lubrication will be of primary importance, especially where conditions of operation may be conducive to entry and accumulation of dust, dirt or other non-lubricating foreign matter.

Automatic delivery of lubricant is, in such cases, subsidiary to pressure available. In the spring type cup the latter is normally lower than where direct application of grease by means of a pressure gun is employed.

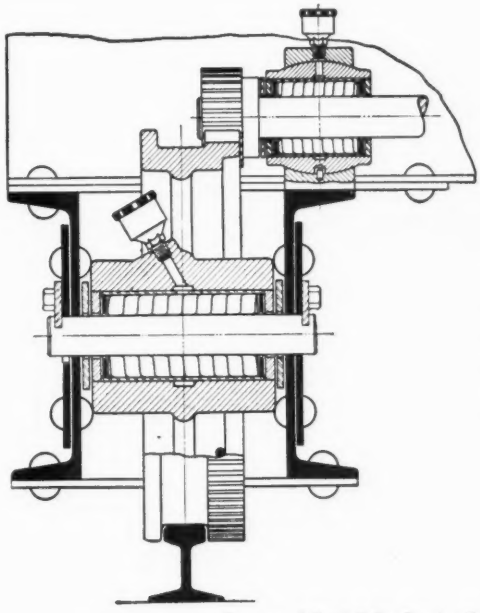
On the other hand, use of the pressure gun in virtually any form requires a certain amount of manual handling. The gun itself must be moved about, flexible hose must be handled, fittings must be wiped clean before attachment of the hose or gun connection, and finally the gun itself must be put into operation. All this requires time, care and good judgment. The latter is especially essential in determining where a bearing has been completely re-lubricated.

In many types of plain bearings, forcing in grease under pressure (as already mentioned) serves as a very effective means of forcing out all old grease and any dirt contained therein. Judgment is necessary, however, in determining when this has been completely accomplished and when to shut off the gun pressure.



Courtesy of Gun-Fil Corporation

Fig. 4—The Gun-Fil constant pressure grease lubricator used in connection with a hand grease gun for the lubrication of escalator bearings.



Courtesy of Hyatt Roller Bearing Co.

Fig. 3—The bridge wheel of a traveling crane showing how the screw-down type of compression grease cup can be employed for roller bearing lubrication.

If properly done, such a method of lubrication is decidedly economical. But if the operator is careless, unobservant, or continues lubrication beyond the necessary extent, he will not only waste grease, but may also cause development of a sloppy condition around the bearings. A slight bulge of fresh grease at a bearing end will usually indicate that complete re-lubrication has been accomplished with the least waste of product.

Types Involved

Pressure lubricators have been mentioned as being of either the hand or power type. For the use of the individual machine operator the former is perhaps the most suitable device, due to its ability to operate by means of hand or foot pressure.

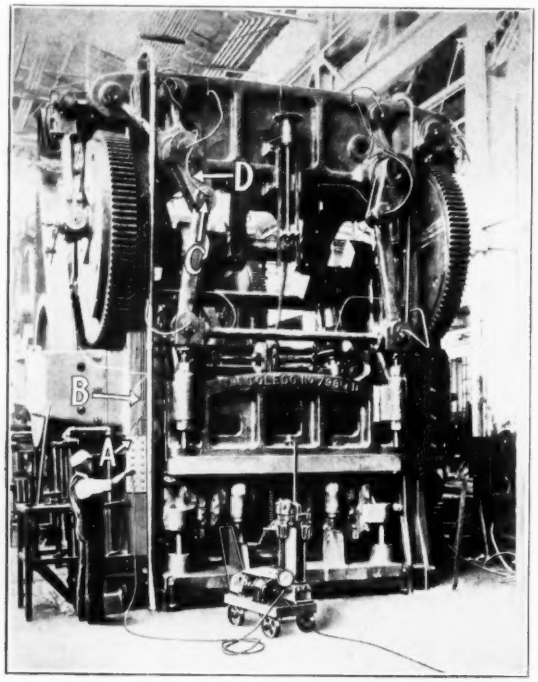
Hand Pressure Guns

Grease guns of the hand pressure type will usually be capable of developing from 1,000 to 10,000 pounds pressure per square inch. They are practicable either with or without hose connections, according to the type of fitting they are designed for, or the location of the part to be lubricated.

Pressure can be applied either before or after attachment of the gun to the fitting. A frequent method of developing pressure is to force down a suitable plunger by means of a threaded stem which screws into a bushing in the head of the gun. Another type of gun involves pump-

ing action by means of the handle and a suitable pressure retaining device.

According to the design, where pressure is to be developed before attachment of the gun to the fitting, a suitable check valve must be installed in the tip. In certain guns the act of attachment opens this valve and automatically permits lubricant to be forced to the bearing.



Courtesy of Dot Lubricating Equipment Co.

Fig. 5—A Toledo press equipped for pressure grease lubrication. "A" indicates point of centralized lubrication showing Dot Nipples for attachment of pressure gun. "B" shows the gang distributing tubes. "C" is a typical universal joint for connecting lubricant channels with bearings of the toggle arms, rocker shafts, etc., and "D" is the flexible hose for the above.

The purpose of designing rigid connection guns with check valves is to eliminate the necessity for relieving the pressure before detaching the gun from the fitting and to enable pressure to be raised before attachment, to overcome the possibility of twisting off the fitting, which might otherwise occur. The direct or swivel jointed connection also does away with the possibility of leaks in the flexible hose.

These factors are especially important where bearings are to be "started" involving the expulsion of grease which has been allowed to remain too long in the grooves or clearance spaces and consequently become gummed, caked and mixed with dirt.

Power Lubricators

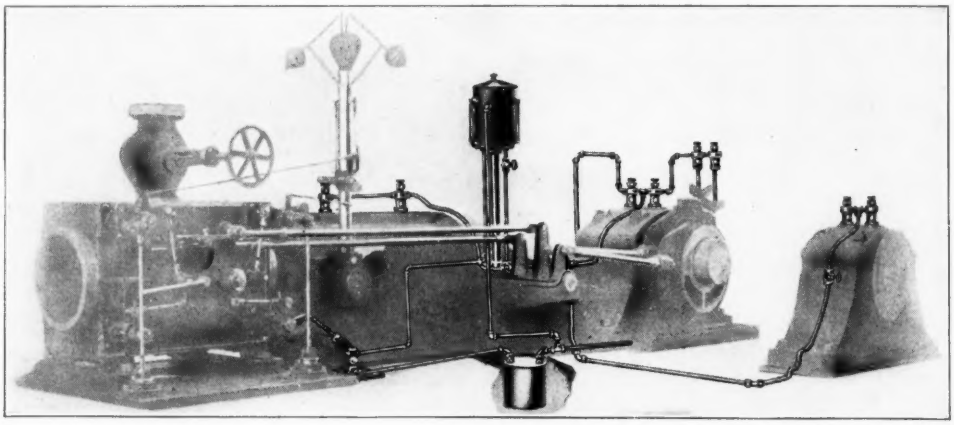
In the garage, greasing station or large industrial plant, however, the hand pressure gun is frequently supplanted by the portable mechanical or power lubricator of considerably greater grease capacity. In general, such lubricators are capable of holding up to 100 pounds of grease.

The smaller capacity guns are chiefly of the hand service type; that is, after pressure is developed grease is discharged by the operation of a pump handle or lever.

A ball or check valve at the base of the pump automatically closes at the end of each stroke to retain all pressure that may have been built up. To insure efficient operation this check valve must, of course, be kept clean. It should, therefore, be inspected at frequent intervals.

Pressures Involved

In such lubricators pressures of from 1,000 to 10,000 pounds are readily developed. These pressures are sufficient to effectively handle the usual grades of greases which are applicable to those strictly chassis parts, such as spring shackles and bolts, steering knuckles and rods.



Courtesy of S. F. Bowser & Co., Inc.

Fig. 6—Showing details of piping necessary in an individual oiling and filtering system for pressure lubrication of the bearings of a Corliss engine.

or mechanical brake connections; or the bearings of the average stoker, metal press, etc.

The increasing preference for a specially compounded lubricant of extremely high adhesive and lubricating ability, however, on such automotive parts as front and rear wheel bearings, universal joints, certain steering gear mechanisms and the clutch will oftentimes require even higher pressures for its effective delivery.

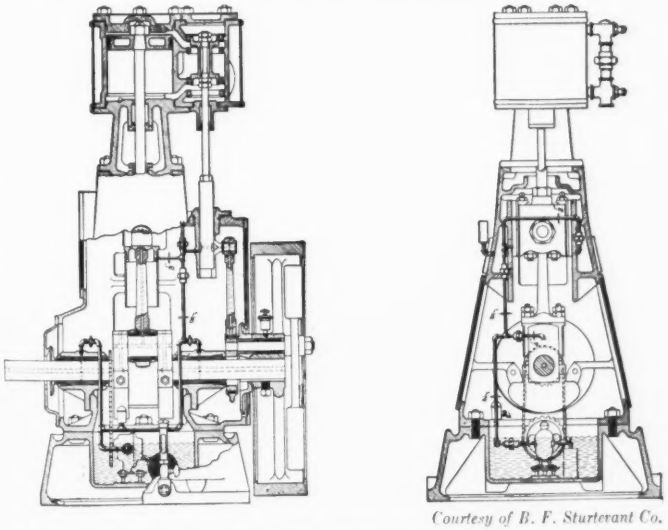
Electric and Pneumatic Compressors

The electric or pneumatic compressor has proved to be the most suitable for the handling of such heavier and more viscous greases. Such lubricators are usually of higher capacity than the hand service type, in certain cases holding as much as 100 pounds of lubricant. In this latter capacity a multi-lead discharge manifold is frequently installed to enable the lubrication of a number of points simultaneously. Such compressors can be either electrically driven, or designed to take their air from an adjacent compressed air line. In other respects, however, the principles of the power lubricator or compressor are much the same as those involved in the hand service type.

An idea of the speed which may be attained with the full automatic electric compressor is gained from the report of a large truck fleet owner who recorded the complete lubrication of ten machines in thirty minutes. This type of equipment may be either stationary or portable, as conditions require.

Pressure Oil Lubrication

In contrast with pressure lubrication by means of grease, it is interesting to note, where oil is involved, that mechanical operation will predominate. In other words, manual application of power is a rarity, with the exception of the so-called "one shot" or centralized pressure systems of lubrication where initial pressure is developed by pushing or pulling a plunger. But even with these there is no direct pressure exerted upon the oil. Such systems, inasmuch as they involve a certain amount of regular attention on the part of the operator, cannot be as automatic as those devices which depend upon the machine for their operation.



Courtesy of B. F. Sturtevant Co.

Fig. 7—A vertical reciprocating engine, equipped for direct pressure or force feed lubrication. A chain-driven gear pump forces the oil to all parts requiring lubrication via piping shown in heavy outline.

This is perhaps the most serious objection to the hydrostatic lubricator for steam cylinder service. It is a pressure device, of course, but dependent upon both manual adjustment and the action of the steam. If the former is not attended to, the lubricator cannot function dependably. In fact, inasmuch as it functions absolutely independently of the engine, pump or compressor which it must serve, it must be started and stopped by the operator each time the former is put in or out of service, and yet once in operation it is an automatic device and quite dependable for positive and economical steam cylinder lubrication.

In other words, where pressure lubrication is involved the more dependent the lubricator is upon machine operation, the more positive can we expect lubrication to become. This is the reason for the popularity of the mechanical force-feed oiler, and the chain or gear driven pump.

CHAIN AND GEAR DRIVEN PUMPS

The development of automotive engine lubrication has brought the gear driven gear pump into decided prominence as a dependable piece of lubricating equipment. It is, in fact, so absolutely automatic as to require no attention whatsoever from the car operator, once it has been properly adjusted to develop the oiling pressures required. These, of course, can be varied according to engine design or the season of the year. A word or so in explanation of the opera-

tion of such a system will be of interest at this point, viz.:

The Automotive Type

The typical pressure system of lubrication as applied to the automotive engine provides for pumping of oil from the reservoir or oil sump in the crankcase directly to the main or crankshaft bearings. From here it passes through suitably drilled holes in the crankshaft to the crankpins.

Courtesy of Norton Company

Fig. 8—Rear of wheel slide of a Norton cylindrical grinding machine, with cover open to show the oil reservoir and chain driven pump for pressure lubrication of the spindle. Flow of oil to bearings can be adjusted by a valve in the bearing cap. Glasses in front enable observation of this oil flow.

Oil as it passes through these latter is thrown to the cylinder walls to maintain the requisite film of lubricant thereon. The pistons and rings are thereby furnished with adequate lubrication as are also the wrist pins within the pistons.

Such a system of lubrication involves no real splashing of oil in view of the fact that there is no provision for dipping of the connecting rods, although a certain amount of oil will be thrown to the cylinder walls as stated above. All excess oil drains back to the oil sump for subsequent redistribution by the pump.

The full pressure system of lubrication differs from the above only in that the wrist pins are also pressure lubricated, oil being delivered via drilled holes in the connecting rods or through separate tubes attached to these latter.

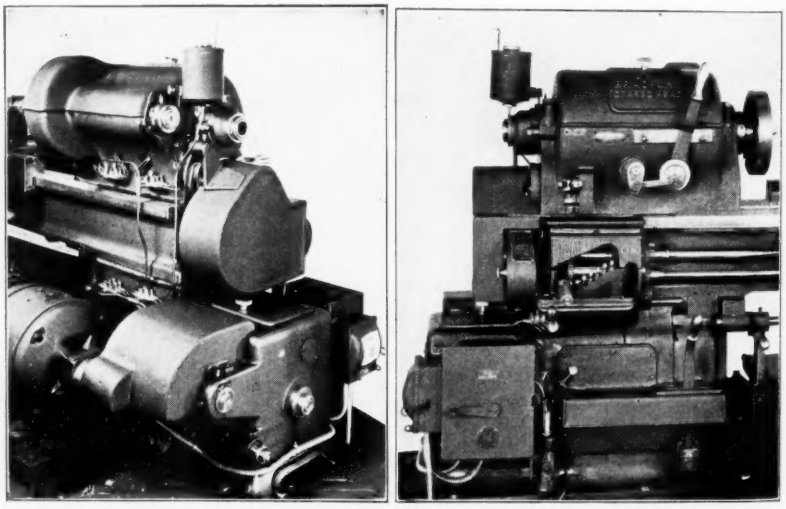
This oil as it passes from the wrist pins serves to supplement the lubrication of the cylinder walls as provided by the oil thrown from the crank-pins. Drainage throughout the engine is returned to the oil reservoir for redistribution.

Industrial and Power Plant Machinery Devices

In connection with industrial and power plant machinery, as illustrated in Figures 7 and 8, the gear and shaft driven pump may be supplanted by chain and sprocket connections. With such equipment the pumping device may be of either of the gear or rotary type. The former is used for example in the vertical reciprocating engine as shown in Figure 7, the rotary pump being in turn employed to deliver oil to the bearings of the grinding machine spindle. (See Figure 8.)

With all equipment of this nature the pump itself must be located below the operating oil level in the base or sump of the machine to be served. As a result, there must be adequate storage capacity to permit of cooling and settling of the return oil as much as possible; for with any system of this nature continuous circulation of oil is developed.

By virtue of the pressure involved in such circulation, and the volume of oil delivered to the wearing elements, this oil serves as a flushing and cooling medium. It is, therefore, natural to expect that more or less contaminating or non-lubricating matter may be accumulated in the course of circulation. In addition, a certain amount of heat may be taken up from the bearings. All this will depend, however, upon how dust-tight the system is, the speed of



Courtesy of Bowen Products Corp.

Fig. 9—Front and rear view of a Bradford lathe showing the provisions for centralized pressure lubrication. In left hand view note the oil reservoir at top, with accessory piping leading to the oil control headers. In the right hand view note the pressure pump and lever at base of the machine.

operation, the bearing pressures, and the proximity to other production or power generating equipment which may develop dust, or high temperatures.

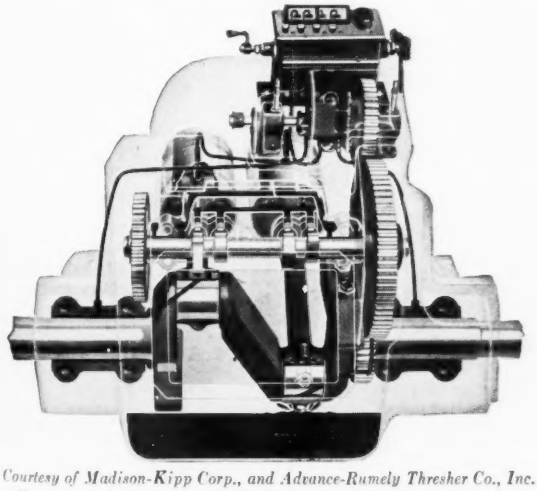
With such equipment, flow of oil can be readily noted by locating sight feed glasses adjacent to the parts to be lubricated. This flow can furthermore be controlled by installing suitable valves in the respective delivery lines.

Necessary Precautions

While built-in systems of lubrication, as mentioned above, are very positive and virtually automatic in regard to the extent to which they maintain lubrication, the matter of periodic changing of oil must never be overlooked.

With the automotive engine this can be done on a mileage basis, dependent of course upon the type of engine and the means provided (in the form of air filters or oil filters) for more or less continuous prevention of oil contamination during operation.

In the case of industrial or power plant machinery, however, operating conditions must be more carefully studied. It will frequently be unwise to assume that change of oil after a certain length of operation will suffice. There are too many controlling factors involved as a rule. The extent to which dust or dirt may be present, the tightness of the system, the rate of oil circulation, the possibility of entry of water, the operating speeds and temperatures and

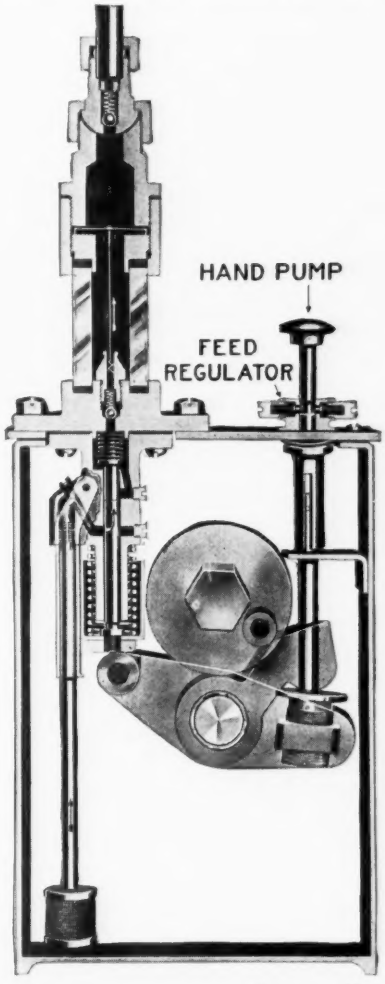


Courtesy of Madison-Kipp Corp., and Advance-Rumely Thresher Co., Inc.

Fig. 10—Lubrication details of a two-cylinder tractor engine using a Madison-Kipp mechanical force-feed lubricator. Note path of oil travel by heavy black lines.

the original purity of the oil must all be considered.

It will be interesting to note, in this regard, that there are instances of grinding machine operation where the lubricant in use has functioned successfully for periods up to a year. With such equipment the nature of construction is such as to effectively prevent any entry of grinding chips, or dust from surroundings. As a result, if the oil screen adjacent to the pump is cleaned regularly the system becomes



Courtesy of Manzel Bros. Co.

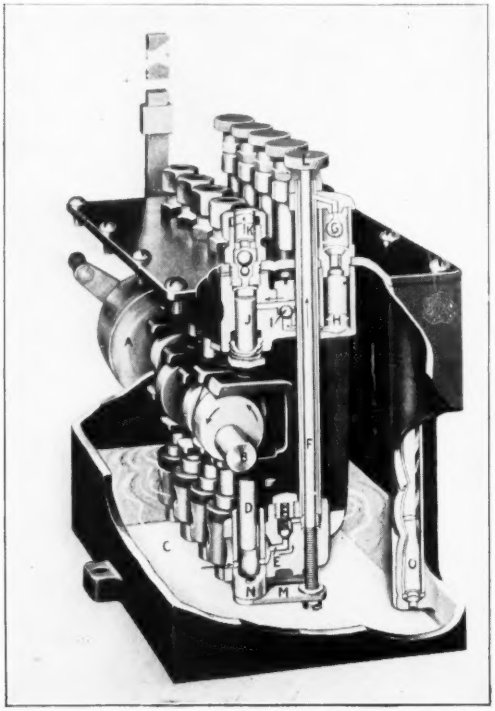
Fig. 11—Cross section of the Manzel Model "82" force feed lubricator. In this device delivery of oil is brought about by a plunger pump operated by a suitable cam mechanism. Volume of oil delivered is regulated by a feed regulator to increase or decrease the plunger stroke through the cam as shown.

decidedly positive and economical from the viewpoint of lubrication.

CENTRALIZED PRESSURE LUBRICATION

Another interesting phase in connection with pressure lubrication has been the development of a system of automatic lubrication which functions by virtue of a central control, all wearing parts so served being flushed and supplied automatically with oil from a central reservoir. By locating this latter adjacent to the machine to be lubricated and within ready reach of the operator, and equipping it with a

suitable plunger which operates the pump, lubrication of all parts connected thereto becomes but a matter of pressing a button, pulling the plunger or turning a wheel whenever necessary



Courtesy of S. F. Bowser & Co., Inc.

Fig. 12—The Model "T" force feed lubricator in detail, designed for lubrication of bearings under pressure. "C" is the oil reservoir, "D" the pump piston, "E" the discharge port, "G" is the sight feed and "H" the discharge chamber. From here oil passes via check valve "I" being drawn in by the down stroke of piston "J". "K" leads to the discharge line, "B" is the cam shaft which rotates the cams to operate the piston pumps, "D" and "J". Arrows indicate path of oil through the lubricator.

or recommended by the builders, according to the operating conditions involved. In such a system the amount of oil fed is restricted to as nearly as possible the theoretical lubricating requirements of the respective bearings. As a result, it may rightly be classified as a "fresh oil" system.

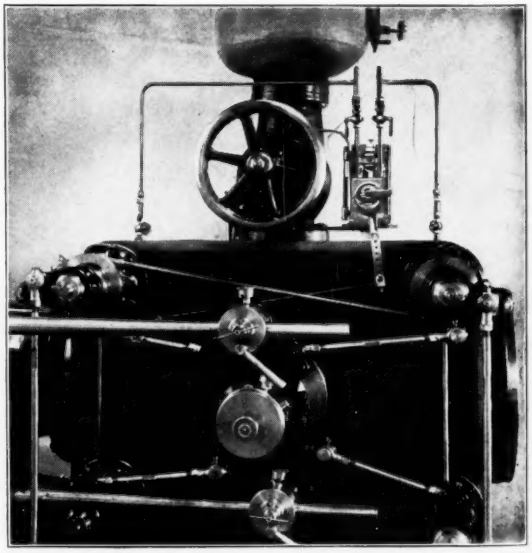
The fact that certain bearings will vary from others in regard to their oil requirements renders it necessary to provide for some arrangement of regulation or control of oil flow. Practically this amounts to a metering of the oil in terms of drops. It can be brought about either by proper individual construction of the drip plugs, which on such equipment are also known as control outlets; by use of a control device located at the base of the pump; or by the installation of suitable adjusting manifolds at salient points in the system.

Properly installed, such systems are claimed to be relatively fool-proof, exceedingly simple to operate, and an insurance that clean oil will be delivered to the respective bearings. It is essential, however, that all parts be of rigid construction and capable of withstanding jars, shocks, and temperature fluctuations, for while piping, etc., is guarded wherever possible, it is relatively impossible to absolutely protect all parts from the chance of contact with external materials.

It is interesting to note that the possibility of entry of dust into such a system is quite as negligible as in a pressure grease lubricator. To further insure that clean oil is used, however, certain central oil reservoirs are equipped with suitable filtering media, such as a felt pad, which is claimed to effectively remove any foreign matter that may have entered the oil in the course of storage or handling prior to usage. Lubricating oils as received from, or delivered by, reputable oil refiners can be relied upon as being free from non-lubricating foreign matter.

THE MECHANICAL FORCE FEED LUBRICATOR

With the mechanical force feed oiler, not only is one-time lubrication involved, but furthermore, oil is delivered in as nearly as possible the requisite amount to meet the bearing or cylinder requirements. With due care when installing and proper adjustment of the rate of oil feed, such lubricators are dependable and decidedly economical.



Courtesy of Greene Tweede Co.

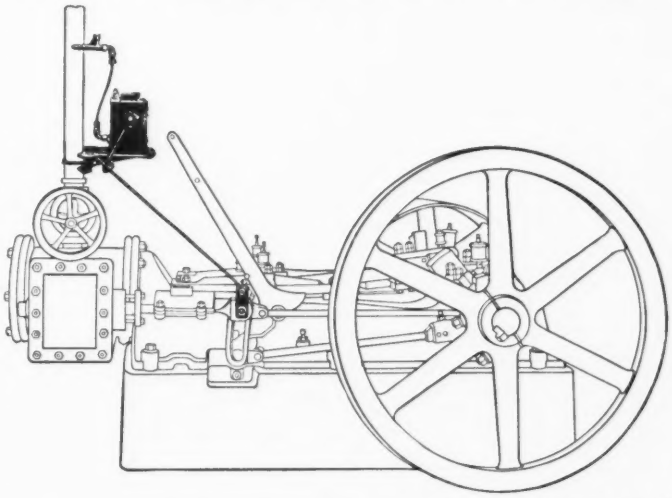
Fig. 13—Installation of a mechanical force feed oiler for lubrication of the valves of a Corliss engine is accomplished as above. Note method of link drive.

There is a further advantage in that by virtue of the fact that such lubricators can be readily driven by the machinery which they serve, they can be made to function only when the

latter is in operation, and then only at a proportional speed. In other words, the higher the speed of operation, the more oil will be delivered. The pumping capacity and rate of oil flow is therefore variable. As a result, such a lubricator will automatically start or stop with the machine or engine to which it is attached.

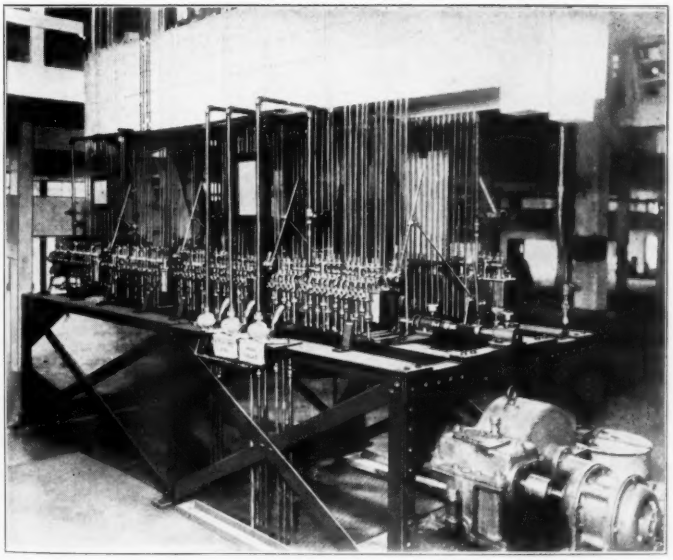
Equipment of this nature is very extensively used for the application of steam cylinder, air compressor or refrigerating compressor oils, viz.: For the lubrication of cylinder, piston and valve wearing surfaces, where reciprocating motion is involved, and where it is practicable to drive the lubricator by direct connection from the crosshead or some other external moving part. This can be brought about by a link mechanism as is generally customary in the case of steam cylinders; or through an eccentric located on some rotating element, such as the cam shaft of a vertical oil engine.

Such lubricators are also widely used for bearing lubrication on metal presses, machine tools, rubber and steel mill machinery. On such equipment rotary driving often is customary, through belt connection from the machine itself or by



Courtesy of Manzel Bros. Co.

Fig. 15—Showing the manner of attaching a force feed oiler to a drilling or hoisting engine. Here the steam is lubricated prior to delivery to the valve chest and engine cylinder.



Courtesy of Hills-McCanna Co.

Fig. 14. Showing how a battery of force feed lubricators can be concentrated. Here eight Hills-McCanna units form an intricate network of 112 oil feeds. All are motor driven from the same shaft through a suitable speed reducer, eccentric arm and bell cranks.

use of an electric motor and speed reduction mechanism.

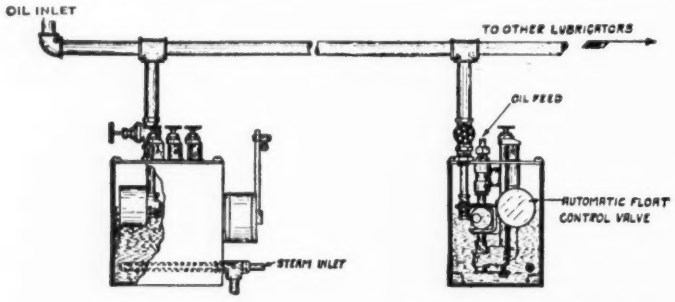
There is more or less of a limitation, however, involved in the usage of a mechanical force feed lubricator, in that the capacity is oftentimes comparatively small in contrast with a flood circulating system, requiring therefore, more frequent refilling. On the other hand, this will depend upon the extent of operation, the number of oil feeds and the rate of delivery. This latter must be worked out in actual practice, according to the requirements of the parts to be lubricated, and the nature and degree of refinement of the oil being used.

Operating Pressures Should Be Studied

In the selection of virtually any means of pressure lubrication, it is important to have at least an approximate idea as to the operating pressures which will prevail between the moving elements. This is especially true in the case of mechanical force feed oilers. Where circulating flood lubrication is involved, volume in company with the pump pressure can be depended upon to maintain the necessary lubricating film between the wearing elements. With the mechanical force feed oiler, on the other hand, pressure alone is involved, for as already mentioned the principle of operation is to deliver oil in as nearly as possible the right amount to maintain effective lubrication and economical operation.

As a result, pump pressure should not vary to any wide degree, nor should the lubricator be allowed to run dry, otherwise lubrication would cease in a comparatively short time.

It is interesting to note, in this regard, that where desirable a central source of supply can be employed. In other words, by suitable connection of a set of force feed oilers as shown in Fig. 16 it is practicable to reduce the labor of filling by bringing this about through a suitable filling line run from the main supply tank. This same illustration shows the practicability of installing a steam heating coil in the bottom of such a lubricator.



Courtesy of S. F. Bowser & Co., Inc.

Fig. 16—Illustration of method of installing force feed oilers in series, in order to enable automatic maintenance of oil supply. Note also means for steam heating in case low temperature operation is necessary.

In certain installations this latter will be a decided advantage, for engines or compressors especially may frequently be exposed to low atmospheric temperatures. In such cases means for pre-heating of the oil prior to delivery will be desirable, otherwise it might easily become so sluggish as to cease to flow through the pumping elements or feed lines. This would be especially true where comparatively high viscosity steam cylinder oils are involved.

Nature of Construction

The typical mechanical force feed oiler consists of a bowl or reservoir of varying capacities ranging normally from one pint to two gallons. Within this reservoir, or attached thereto, is the pumping element or block. To this latter is attached the operating ratchet, clutch or belt connection.

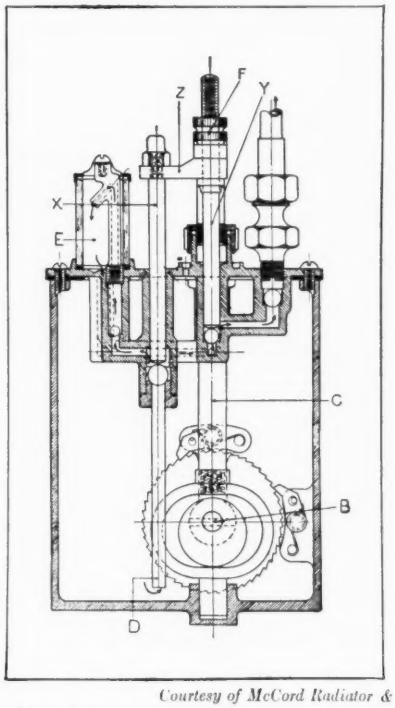
The design of pump employed will depend upon the type of lubricator. In general, it will involve a piston or plunger. According to the service involved, quite a number of such pumping units can be embodied in the one lubricator. Furthermore, this latter can be divided into two or more parts so that more than one grade of oil can be delivered by the same lubricator. Where this latter prevails, however, care must be observed in filling in order to make sure that the right oil is always put in the proper compartment.

Actual operation of the pumping element is brought about by an eccentric or cam located usually within the reservoir. It receives its motion through the exterior operating mechanism such as the ratchet. It is practicable to arrange the design so that each pumping unit will operate independently, and capable of individual regulation. In order that the extent of lubrication or rate of pumping can be observed, oil is delivered from the pump unit through a suitable gauge glass or sight feed device. The purpose of locating this latter in the discharge line is, of course, to enable observation of oil flow, after the lubricator has functioned.

PRESSURE APPLICATION OF GEAR LUBRICANTS

It will also be interesting to note that automatic means for pressure application of gear lubricants has been developed for the collective lubrication of reduction gears.

In the course of lubrication of gearing, especially on many types of industrial machinery, the matter of assuring positive, cleanly and economical application of lubricants to the gear teeth may become a problem. This will be particularly true where gears are exposed, or but partly enclosed, for in such installations the tendency of lubricants to be thrown off by the action of centrifugal force must be guarded against.



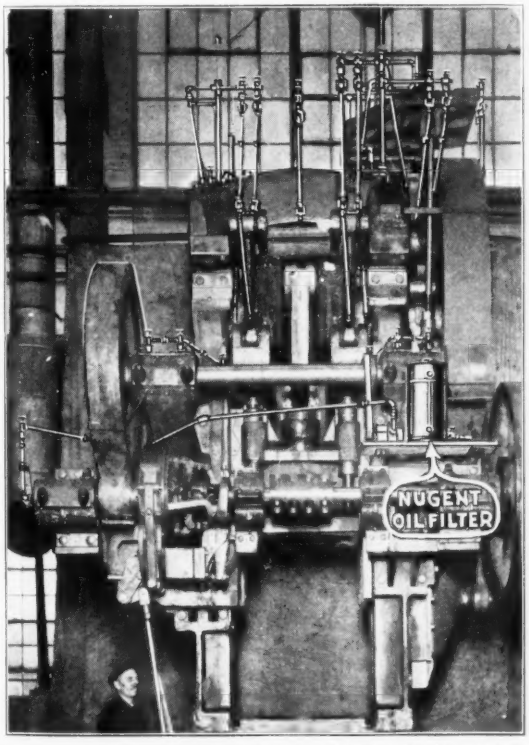
Courtesy of McCord Radiator & Mfg. Co.

Fig. 17—The mechanism of a ratchet driven mechanical lubricator. The main shaft "C" driven by eccentric "B" moves yoke "Z" and operates "X" and "Y" the primary and delivery plungers. "E" is the sight feed; "D" the oil inlet.

This will, however, depend upon the viscosity and adhesive characteristics of any lubricant. Where application or re-lubrication is to be done by hand, these characteristics must be given very careful consideration, otherwise not only may the gear teeth suffer, but also a sloppy condition may prevail, due to dripping or throwing off of the lubricant.

For this reason gears are housed or guarded wherever practicable. Furthermore, means for automatic lubrication have been extensively studied by machinery builders. The simplest way to attain this is, of course, to enclose at least the lowermost parts of the gears in an oil-tight housing, and provide for bath lubrication.

This, however, does not obviate the possibility of more or less of an excess of lubricant being carried out from the bath to be perhaps thrown off from the teeth at some tangent during completion of rotation of the gear. This will be especially possible if too light a product is being used, or if it is not sufficiently adhesive

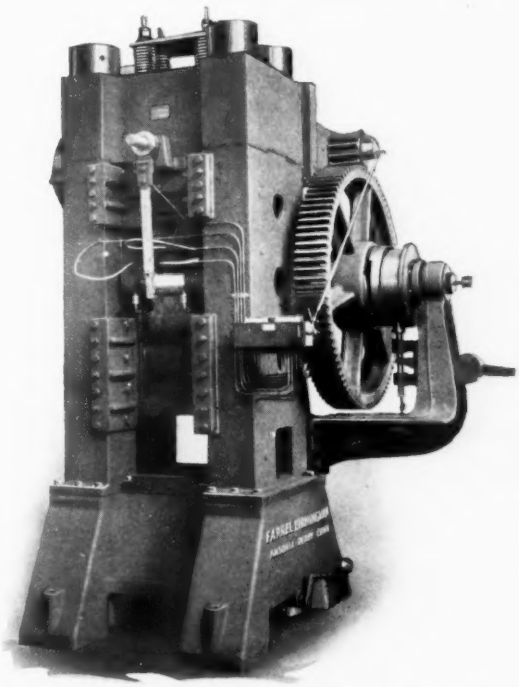


Courtesy of William W. Nugent & Co.

Fig. 18—Back view of a drawing press showing the oil filter and pump installation. Note the series of oil piping, and connections to the various press bearings, etc. Pressure lubrication is maintained throughout.

to stick to the wearing surfaces of the gears.

By resorting to some means of delivering a gear lubricant to the teeth as they pass into mesh, in more nearly the right amount to maintain lubrication, the above can frequently be checked. Pressure has been developed as being a very practicable means of accomplishing same. This may be mechanical, and dependent upon the operation of the machine itself; or the lubricating system may function



Courtesy of Farrel-Birmingham Co., Inc.

Fig. 19—Showing a 700 ton knuckle joint press equipped for pressure lubrication using a McCord force feed oiler.

independently, using compressed air, for example.

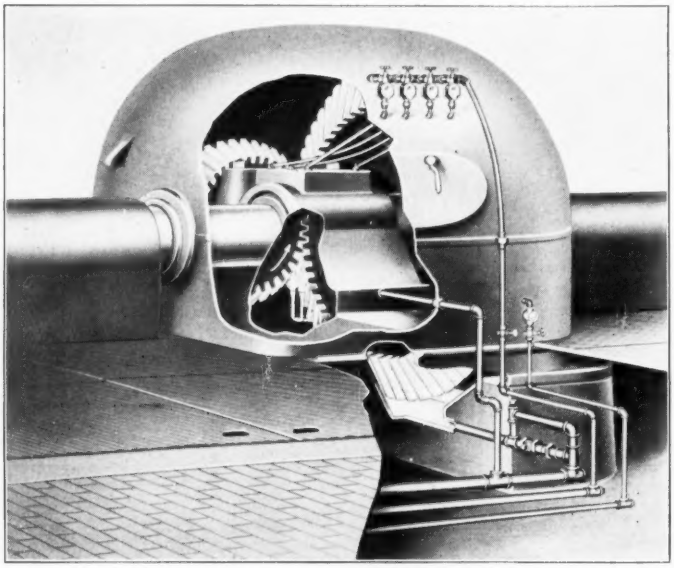
Steam Turbine Practice

Pressure lubrication of the reduction gears of certain types of steam turbines has long been practiced. In such installations, the mechanically driven gear pump is extensively used, the pressure developed depending upon the size and relative speed of the gears. Where such systems of lubrication are involved, it is important to remember that the same oil is very frequently delivered likewise to the bearings.

As a result, certain other characteristics, such as the resistance to emulsification, must be given prior consideration. Adhesiveness is normally not a factor in the lubrication of turbine gears for the development of flood lubrication, and the oil-tight nature of most turbine gear cases is an insurance of positive lubrication and general machine cleanliness.

It will be interesting to note that the viscosity of turbine oils for reduction geared units will normally range from 300 to 750 seconds Saybolt at 100 degrees Fahrenheit, dependent upon the size of the installation, the speed of

operation, and the tooth pressures involved. It is important to remember that an oil for such service should never be of any higher viscosity than is absolutely needed, due to the fact that



Courtesy of S. F. Bowser & Co., Inc.

Fig. 20—Circulating pressure lubrication as applied to a set of enclosed bevel gears. Piping details are clearly shown. Such a system of flood and pressure lubrication should effectively protect and lubricate the gear teeth.

rate of separation from water will vary directly as the viscosity or body of the oil.

Industrial Types

It is of course practicable to lubricate other similar installations of reduction gears in like manner. This has been particularly developed in connection with certain types of steel mill drives. Here however, the lubrication requirements will not be as exacting as in the case of the steam turbine. It is primarily a matter of gear lubrication and therefore the oil can be more nearly chosen to meet the actual gear requirements.

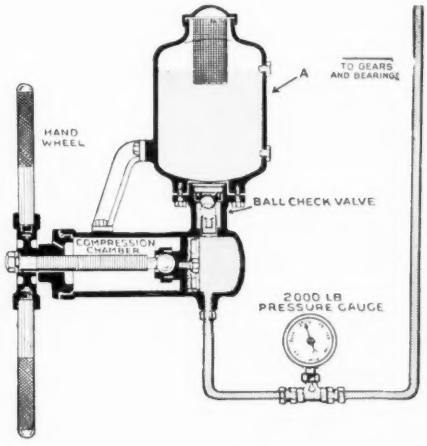
Lubrication of the adjoining gear and pinion shaft bearings is a relatively simple matter, the oil being delivered via suitable leads and connections under the same pressure as it is to the gears. For such service the viscosity range will normally be from 70 to 100 seconds Saybolt at 210 degrees Fahrenheit.

Use of Air Pressure

Multiple lubrication by means of compressed air power has also been tried out for certain cases of sugar mill and other large gears operating exposed. In such a system specially designed lubricating pumps equipped with removable lubricant containers are installed at each point of lubrication. These pumps are all connected to a common air control device, which in turn is supplied with proper air supply and exhaust connections. Compressed air can be taken from a suitable source adjacent to the machine itself or from an air line elsewhere in the plant.

At regular and controlled intervals air is applied via the control mechanism, simultaneously to all the lubricator pumps in the system, a predetermined supply of lubricant being subsequently delivered to each set of gears at their point of mesh. The gear shaft bearings may be similarly lubricated. In view of the fact that the air control mechanism is driven directly from the machine to be lubricated, through suitable belt or chain connection, lubrication is only carried out while the latter is in operation.

In such a system comparatively heavy gear lubricants can be used, of a viscosity as high as 1000 seconds Saybolt at 210 degrees Fahrenheit. Such products, if of straight mineral nature will have a high degree of adhesiveness, and but a very small quantity will be required to maintain an adequate protective lubricating film. Where application or renewal is automatically



Courtesy of Lubrication Devices, Inc.

Fig. 21—Showing the Farmer centralized system of lubrication. With this device, it is practicable to accomplish complete lubrication of both gears and bearings by a turn of the hand-wheel as shown above. At "A" is shown the oil or grease reservoir of any desired capacity.

carried out in measured quantities, the possibility of dripping or accumulation to sufficient extent to throw off should be decidedly reduced.

Printed in U. S. A. by
EDGAR C. RUWE CO., INC.
72 Washington St., N. Y. C.